

### Remarks

Claims 1-18 are pending in the application.

### Double Patenting

Claims 1 and 16 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 8 and 12, respectively, of U.S. Patent No. 7,206,969. Applicants hereby submit a terminal disclaimer to overcome this rejection.

### Claim Rejections – 35 USC 103 (Metzger and Quach)

Original claims 1-3 and 18 were rejected under 35 USC 103 as being unpatentable over Metzger (US 7,269,827) in view of Quach (US 6,640,313). This rejection is respectfully traversed.

Claim 1 expressly recites, “A method of compiling a program to be executed on a target microprocessor with multiple functional units of a same type, the method comprising **opportunistically** scheduling a **redundant** operation on one of the functional units that would otherwise be idle during **a cycle**.” (Emphasis added.) Applicants respectfully submit that this claim limitation is not disclosed or suggested by Metzger in view of Quach.

As stated in the office action, Metzger does not disclose a target microprocessor **with multiple functional units of a same type**. (Office Action, page 4, line 4.) Applicants agree with this observed deficiency in Metzger.

Furthermore, beyond that deficiency, applicants respectfully submit that there are further deficiencies in Metzger. In particular, Metzger does not disclose “**opportunistically** scheduling a **redundant** operation on one of the functional units that would otherwise be idle during **a cycle**.” (Emphasis added.)

In relation to these claim limitations, the office action cites to column 5, lines 60-64 of Metzger. The discussion below explains the reasons why this citation to Metzger does not disclose these claim limitations.

First, claim 1 expressly recites “**opportunistically** scheduling” if a functional unit is “idle during **a cycle**.” In other words, the claimed invention

takes opportunistic advantage of *even a single cycle* which would otherwise be idle. In contrast, Metzger states, “Should a functional unit be detected as idle for a **period of time exceeding a threshold**, then changes may be implemented in the IR 301, as may be required or useful, to utilize the idle function in the target architecture.” (Col. 5, lines 60-63, emphasis added.) In other words, Metzger teaches making changes if the functional unit is idle for an *excessively long time period* (beyond the threshold period). Hence, there is no disclosure in the citation to Metzger of opportunistic scheduling if a functional unit is “idle during **a cycle**.”

Second, claim 1 expressly recites that the idle functional unit should be opportunistically scheduled with “a **redundant operation**.” In contrast, Metzger merely states in a very general manner that the changes are made “to **utilize** the idle function in the target architecture.” (Col. 5, line 63, emphasis added.) It is respectfully submitted that the more specific limitation of claim 1 is patentable over the much more general statement in Metzger.

Regarding Quach, Quach pertains to **microprocessor design**. Quach does not relate at all to the entirely different technical field of **program compiler design**. As the claimed invention relates to program compiler design, applicants respectfully submit that the teachings of Quach relating to microprocessor design are pertinent. For example, the method of claim 1 recites “scheduling” an operation by a compiler, while no such scheduling is performed by a microprocessor.

Furthermore, claim 1 expressly recites “**opportunistically** scheduling a redundant operation on one of the functional units that would otherwise be idle during a cycle.” In other words, redundant operations are not always scheduled by the compiler; rather, they are scheduled opportunistically to take advantage of otherwise idle cycles. In contrast, Quach discloses a microprocessor with two different **operating modes**, an HP (high performance) mode and an HR (high reliability) mode. In HR mode, the multiple functional units are **always provided with the same instructions** by the issue unit, while the multiple functional units process different instructions in HP mode. See, col. 6, lines 1-13, which states, “In HR mode, issue unit 120 provides identical instructions to execution clusters 140(a) and 140(b). ... In HP mode, execution clusters 140(a) and 140(b) may

be controlled independently to process different instructions.” (Emphasis added.) Hence, there is no disclosure in Quach of “**opportunistically scheduling a redundant operation** on one of the functional units that would otherwise be idle during a cycle.”

For at least the above discussed reasons, applicants respectfully submit that claim 1 overcomes this rejection.

Claims 2-3 depend from claim 1 and so also overcome this rejection. In addition, claim 2 further recites “**scheduling a comparison** of results from the redundant operation.” (Emphasis added.) In contrast, the microprocessor of Quach has a check unit 160 which, when activated in HR mode, compares execution results. As such, no such compiler scheduling of a comparison is needed or disclosed by Quach. Metzger also does not disclose any such compiler scheduling of a comparison.

Claim 18 is an independent computer-readable program product claim with limitations similar to those of claim 1 and 2 combined. Claim 18 also overcomes this rejection for at least the reasons discussed above in relation to claim 1 and 2.

#### Claim Rejections – 35 USC 103 (Metzger, Quach, and Fruehling)

Original claim 4 is rejected under 35 USC 103 as being unpatentable over Metzger (US 7,269,827) in view of Quach (US 6,640,313) and further in view of Fruehling (US 6,625,688). This rejection is respectfully traversed.

Claim 4 depends from claims 1 and 2. Hence, claim 4 is patentably distinguished over Metzger in view of Quach for at least the reasons discussed above in relation to claims 1 and 2. Fruehling is cited in relation to different levels or modes and does not cure all the deficiencies of Metzger and Quach. Therefore, applicants respectfully submit that claim 4 overcomes this rejection.

Claim Rejections – 35 USC 103 (Metzger, Quach, and Raina)

Original claims 5-10 and 14-15 were rejected under 35 USC 103 as being unpatentable over Metzger (US 7,269,827) in view of Quach (US 6,640,313) and further in view of Raina (6,134,675). This rejection is respectfully traversed.

Independent claim 5 recites a method of compiling which includes: “identifying **a cycle** during which an operation is available for a first functional unit and **no** operation is available for a second functional unit, wherein the first and second functional units comprise functional units of a **same** type; scheduling the operation for execution by **both** the first and second functional units during the cycle; and **scheduling a comparison** of results obtained by the first and second functional units during a subsequent cycle.” (Emphasis added.) The limitations of claim 5 are similar in scope to the combined limitations of claims 1 and 2.

Therefore, claim 5 is patentably distinguished over Metzger in view of Quach for at least the reasons discussed above in relation to claims 1 and 2. Raina is cited in relation to scheduling a comparison of results and does not cure all the deficiencies of Metzger and Quach. Therefore, applicants respectfully submit that claim 5 overcomes this rejection.

Claims 6-10 and 14-15 depend from claim 5. Hence, claims 6-10 and 14-15 are patentably distinguished over the combination of Metzger, Quach and Raina for at least the reasons discussed above in relation to claim 5.

Claim Rejections – 35 USC 103 (Metzger, Quach, Raina, and Chan)

Original claims 11, 13 and 16-17 were rejected under 35 USC 103 as being unpatentable over Metzger (US 7,269,827) in view of Quach (US 6,640,313) in view of Raina (6,134,675) and further in view of Chan (US 5,557,761). This rejection is respectfully traversed.

Claims 11 and 13 depend from claim 5. Hence, claims 11 and 13 are patentably distinguished over the combination of Metzger, Quach and Raina for at least the reasons discussed above in relation to claim 5. Chan is cited in relation to the general disclosure of a scheduler in a program compiler. Applicants respectfully submit that Chan does not cure all the deficiencies

discussed above in the combination of Metzger, Quach and Raina. Therefore, applicants respectfully submit that claims 11 and 13 are also patentable over the cited art.

Independent claim 16 recites limitations similar to the limitations of claim 1. Thus, claim 16 is patentably distinguished over the combination of Metzger and Quach for at least the reasons discussed above in relation to claim 1. The addition of Raina and Chan does not cure all the deficiencies of Metzger and Quach. Therefore, applicants respectfully submit that claim 16 is also patentable over the cited art.

Claim 17 depends from claim 16. Hence, claim 17 is also patentable over the cited art.

Claim Rejections – 35 USC 103 (Metzger, Quach, Raina, Chan, and Fruehling)

Original claim 12 was rejected under 35 USC 103 as being unpatentable over Metzger (US 7,269,827) in view of Quach (US 6,640,313) in view of Raina (6,134,675) in view of Chan (US 5,557,761) and further in view of Fruehling. This rejection is respectfully traversed.

Claims 12 depends from claim 5. Hence, claim 12 is patentably distinguished over the combination of Metzger, Quach and Raina for at least the reasons discussed above in relation to claim 5. Chan is cited in relation to the general disclosure of a scheduler in a program compiler, and Fruehling is cited in relation to a conventional comparator. Applicants respectfully submit that the addition of Chan and Fruehling does not cure all the deficiencies discussed above in the combination of Metzger, Quach and Raina in relation to claim 5. Therefore, applicants respectfully submit that claim 12 is also patentable over the cited art.

Conclusion


Applicants respectfully submit that all the claims have been patentably distinguished over the cited art. Favorable action is respectfully requested.

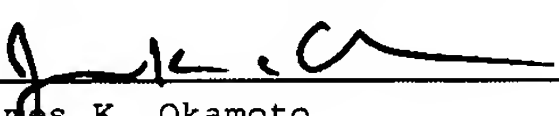
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Respectfully Submitted,

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